MOKELUMNE RIVER HEARING

BEFORE THE
STATE WATER RESOURCES CONTROL BOARD

EBMUD

EAST BAY MUNICIPAL UTILITY DISTRICT

WATER QUALITY IMPACTS

TESTIMONY OF DALE D. NEWKIRK

NOVEMBER 1992

EBMUD Exhibit No. 31

average of about 30 ug/L to an average of 80 ug/L and a high of over 120 ug/L (see Figure 4). Similar effects were experienced at the terminal reservoirs where the Delta blend ratio reached 30 percent at times. THM levels averaged 70 ug/L at Upper San Leandro Reservoir and swung toward brominated species. It took about 5 years for the THM influence of Delta water to subside to pre-Delta blend levels (see Figure 5). Taste and odor problems also were prevalent during and after this period of using Delta water. EBMUD's experience with Delta water confirmed that use of a lower quality source water can cause significant water quality and treatment problems.

Summary. The combination of the many sources of contamination, including those described above, degrade Delta water quality below that of contributory streams. Table 2 below shows typical values of Delta water quality for key parameters. Pardee water quality for the same parameters is shown for comparison.

Table 2

Key Water Parameters in the Delta and Pardee Reservoir, 1988 to 1990

Parameter	Unit	Delta @ Indian Slough, 1988-90			Pardee Reservoir, 1988-90		
		Minimum	Average	Maximum	Minimum	Average	Maximum
Bromide	mg/L	<0.05	0.44	0.87	<0.01	0.007	0.02
Chloride	mg/L	18	128	260	1	3	4
Odor	TON	0	2	12	0	0.5	6
Total Dissolved Solids	mg/L	130	383	650	28	34	40
THMFP	ug/L	140	250	440	35	47	69
Total Organic Carbon	mg/L	1.2	3.4	29	1	1.7	3.3
Total Coliforms	#/100 mL	2	170	110,000	<2	8	3,000
Turbidity	NTU	3.1	10.9	50	0.23	0.42	0.83

Source: EBMUD Water Quality Monitoring Data

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The Total Coliform Rule (TCR), which has existed since 1975, was overhauled in 1989. The MCL for coliform bacteria is now based on a presence or absence concept rather than coliform density. Compliance is determined by the percentage positive samples in a month, and is generally considered more stringent than the original version. This will generally result in a higher level of disinfection, since maintenance of a distribution system disinfectant residual is vital to consistent compliance with the TCR.

Disinfectant/Disinfection Byproduct Rule. At present, the only disinfection byproducts that have been regulated are the trihalomethanes (THM), including chloroform, bromodichloromethane, dibromochloromethane, and bromoform. These are limited to a total trihalomethane (the sum of the four identified species) MCL of 100 ug/L. The EPA is charged with developing a new Disinfectant/Disinfection Byproduct Rule by 1995. This is a daunting task. With the recent rapid advancement in analytical chemistry, the occurrence of a wide array of disinfection byproducts has been demonstrated; the existence of a great many more is suspected. Conducting risk assessments on these compounds (which typically involves extrapolation of toxicological data from animal testing to humans), and assigning acceptable risk levels (which generally includes consideration of technical and economic feasibility) is a laborious and time-consuming task. It is generally believed that the new regulation to be promulgated in 1995 will lower the MCL for trihalomethanes, and possibly set separate MCLs for some byproducts. This could limit the levels of disinfection possible, or lead to the requirement for expensive treatment modifications to remove byproduct precursors prior to disinfection, or to remove disinfection byproducts subsequent to disinfection.

Conflicting Regulations and Delta Water. At present, there are three common disinfectants: chlorine, chloramines, and ozone. Chlorine is a powerful disinfectant, with many identified byproducts including trihalomethanes (see Figure 6). Chloramine is a less powerful disinfectant, with fewer known byproducts, which does not form trihalomethanes. Ozone is an extremely powerful disinfectant, with fewer known byproducts, which is known to form bromoforms and bromate (see Figure 7). As illustrated in Figure 7, what we know about ozone is the "tip of the iceberg;" there is much more that we do not know about its potential side effects. It is possible at present to meet both the Surface Water Treatment Rule and the THM MCL of 100 ug/L using these disinfectants on Delta water. Typically, chlorine or ozone is used as a primary disinfectant, and chloramine is used to maintain a residual in the distribution system. However, use of these disinfectants with existing treatment processes is at risk under the new disinfectant/disinfection byproduct rule. For example, if the existing THM level of 100 ug/L is lowered to 50 ug/L or less, it might not be possible to use chlorine as a primary disinfectant. If bromate, a suspected carcinogen, is regulated, it might not be possible to use ozone, which converts bromide (present in the Delta because of sea water intrusion) to bromate. Chloramine itself could receive an MCL which restricts its use. And a whole host of as yet unknown byproducts could receive MCLs which limit the use of chlorine, ozone, or chloramine.

Because of this conflict, EPA is reconsidering the use of its traditional risk model for these contaminants. Rather, it will attempt to balance the health effects of long-term exposure to disinfection byproducts with the risk of acute disease from pathogen exposure due to inadequate disinfection treatment. This is a common sense approach, although it may lead to establishment of MCLs which are heavily influenced by technological and economic considerations, but which allow exposure to potentially dangerous levels of byproducts.

Clearly, the major variable contributing to carcinogenic risk from disinfection byproducts is the source water. In theory, contaminants in water can be monitored and removed to achieve mandated standards by water treatment processes. However, it is anticipated that regulatory requirements will continue to become more complex as analytical techniques improve and more compounds are discovered that are of potential public health significance. Reliance upon treatment as a substitute for a high quality source may not assure adequate removal of contaminants which may be discovered in the future. Notwithstanding regulation of disinfection byproducts by EPA, regulations themselves will not limit the introduction of organic

Treatment Goals. Because of the present unstable regulatory environment, the level of treatment that will be required in the future for Delta water is uncertain. Therefore, for purposes of estimating the range of costs that are possible, cost estimates were developed for two levels of treatment:

1. **Treat to Meet Existing Regulations.** The assumed process components necessary to meet existing regulations were based on the recently completed Contra Costa Water District Randall Bold plant. Process components assumed include rapid mixing, pre-ozonation, flocculation, sedimentation, dual media filtration at 6 gallons per minute per square foot with granular activated carbon and sand, post-ozonation, and chloramination.

2. **Treat to Meet Possible Future Regulations.** To estimate the upper boundary of treatment necessary to meet future regulations, treatment to remove dissolved salts was assumed, to provide for the removal of chlorides, bromides, and total organic carbon. This would essentially upgrade the Delta water to somewhere near Mokelumne quality. Process components assumed include grit removal/ sedimentation, pre-ozonation, biological activated carbon, microfiltration, acid addition, reverse osmosis, scale treatment, and chloramination. It was assumed that brine could be disposed of by discharge into the Bay at Carquinez Straights.

Estimated Treatment Costs. EBMUD's current water right allocation is 364,000 acre-feet per year, which is equivalent to 325 mgd; the capacity of the Mokelumne aqueducts. In order to develop a range of costs, treatment costs were developed for three capacities: 60 mgd (approximate capacity of existing Bixler pump station), 134 mgd, and 325 mgd.

The development of the costs of using Delta as a partial or complete water source is set out in Appendix A-6, summarized below, and shown graphically on Figures 10 and 11.

Estimated Costs of Delta Water Treatment

Capacity (mgd)	Lower bound (existing regulations) $ millions		Upper bound (possible future regulations) $ millions	
	Capital cost	Annual operating cost	Capital cost	Annual operating cost
60	119	31	567	56
134	276	43	1,020	120
325	470	160	1,789	284

CONCLUSION

Utilities who now use Delta water as a drinking water supply, because they have no feasible alternative, face a challenging and uncertain future: uncertain chronic health risks from known and unknown contaminants, increasing and potentially conflicting regulations, uncertain effectiveness of treatment technologies, problems with taste and odor, and high costs. It would be poor public policy to force EBMUD, which does have an alternative, to face the same challenges and uncertainties notwithstanding the investment of hundreds of millions of dollars in additional treatment facilities. Such a determination would be inconsistent with the policy adopted by the voters in their enactment of Proposition 65--The Safe Drinking Water and Toxic Enforcement Act of 1986. Proposition 65 as submitted to the voters in the general election declares, in part:

"Section 1. The people of California find that hazardous chemicals pose a serious potential threat to their health and well-being, that state government agencies have failed to provide them with adequate protection, and that these failures have been

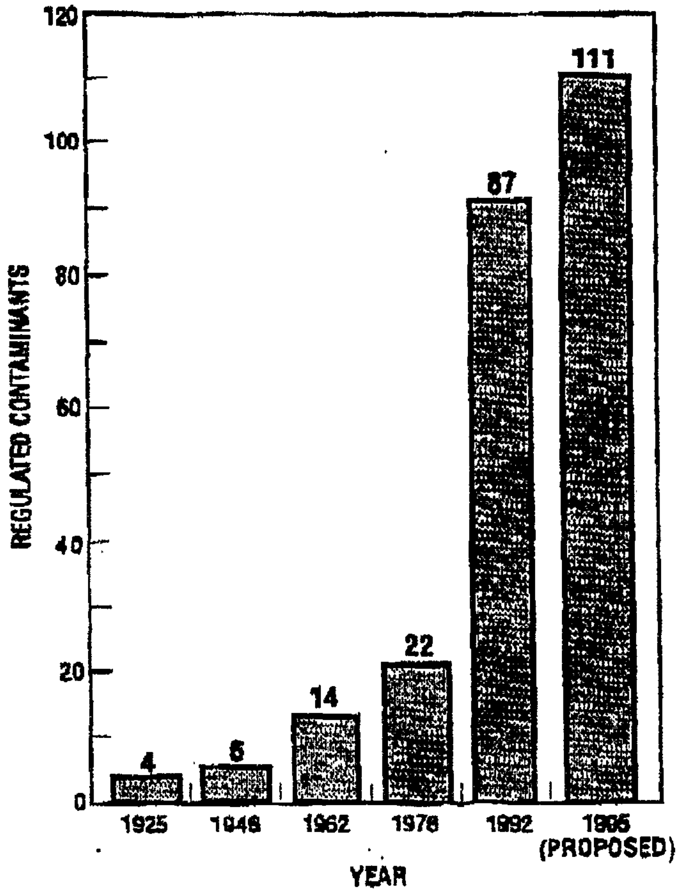


Figure 1 Contaminants Regulated by the U.S. Government

Figure 2 EBMUD Post-Treatment Water Compared to Select Federal and State Primary Drinking Water Standards (1990)[1]

Parameter	Unit	Federal MCL	State MCL	EBMUD range	EBMUD Average
Turbidity	NTU	1	0.5	0.02 - 0.11	0.05
Coliform Bacteria	cfu/100 mL	1	1	0 - 0.24	0.028
Total Trihalomethanes	mg/L	100	100	4 - 78	38
DBCP	mg/L	0.0002	0.0002	<0.00002	<0.00002
Aluminum	mg/L	NS	1	0.063 - 0.110	0.10
Barium	mg/L	1(0.5*)	1	0.002 - 0.021	0.01
Arsenic	mg/L	0.05	0.05	<0.001	<0.001
Cadmium	mg/L	0.010(0.005*)	0.01	<0.001	<0.001
Chromium	mg/L	0.05(0.1*)	0.05	<0.002	<0.002
Fluoride	mg/L	4	1.4 - 2.4	0.05 - 1.09	0.85
Lead	mg/L	0.05	0.05	<0.002	<0.002
Mercury	mg/L	0.002	0.002	<0.0005	<0.0005
Nitrate (as N)	mg/L	10	10	0.007 - 0.15	0.02
Selenium	mg/L	0.01(0.05*)	0.01	<0.002	<0.002
Silver	mg/L	0.05	0.05	<0.003	<0.003
Chloride	mg/L	250	250**	3 - 10	5
Color Units	mg/L		15	6	6
Iron	mg/L	0.3	0.3	<0.02 - 0.02	0.02
Odor	TON		3	0 - 3	0
Sulfate	mg/L	250	250**	2.3 - 14	4.4
TDS	mg/L	500	500**	44 - 133	59
Zinc	mg/L	5	5	<0.003 - 0.009	<0.003
Calcium	mg/L	NS	NS	6.7 - 19	8.6
Hardness	mg/L	NS	NS	22 - 82	29
Magnesium	mg/L	NS	NS	0.73 - 7.4	1.5
pH	Units	NS	NS	8.2 - 9.2	8.6
Potassium	mg/L	NS	NS	0.6 - 1.2	0.7
Sodium	mg/L	NS	NS	2.4 - 16	4.2

Notes: (1) = EBMUD levels from 1990 Annual Water Quality Report
** = Recommended Maximum Level
MCL = Maximum Contaminant Level
NS = No Standard

Figure 3 Major Wastewater Treatment Plants

Facility	Average flow, mgd	Basin location
Sacramento Regional	150	Sacramento
Stockton Main	29	San Joaquin
Roseville	11.8	Sacramento
Visalia	8.6	Tulare
Turlock	8	San Joaquin
Vacaville Easterly	6	Sacramento
Merced	5.5	San Joaquin
West Sacramento	4.5	Sacramento
Tracy	4	San Joaquin
Davis	3.6	Sacramento
Redding, Clear Creek	3.5	Sacramento
Oroville	3.5	Sacramento
Chico Main	3	Sacramento
Atwater	2.9	San Joaquin
University of California	1.8	Sacramento
Grass Valley	1.6	Sacramento
EID Deer Creek	1.5	San Joaquin
Red Bluff	1.2	Sacramento
Anderson	1.2	Sacramento
Placerville, Hangtown Creek	1.2	Sacramento
Beale Air Force Base	1.1	Sacramento
Olivehurst PUD	1	Sacramento
Other	13.8	All
Total	268.3	

Figure 6

CHLORINATION BY-PRODUCTS

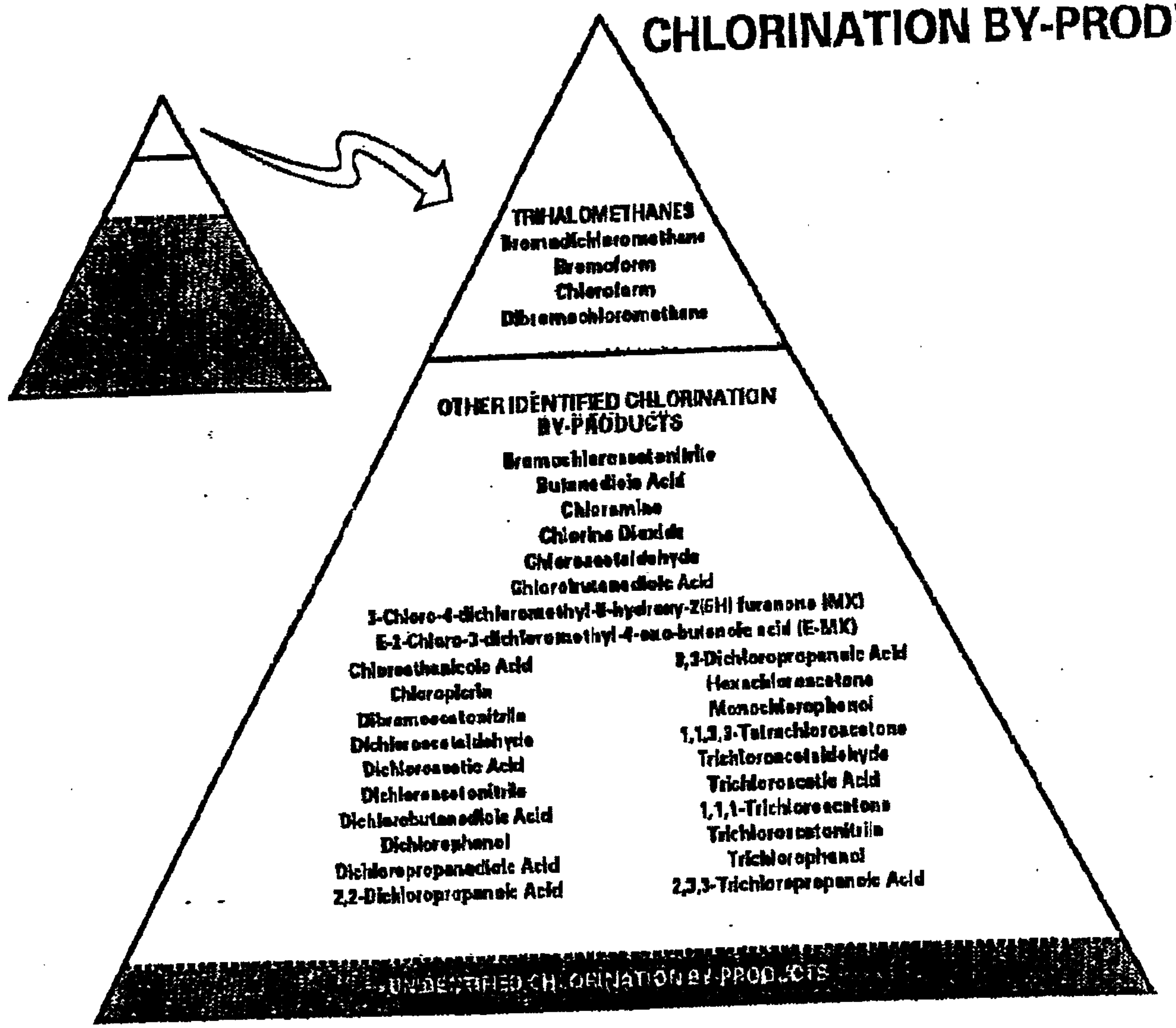
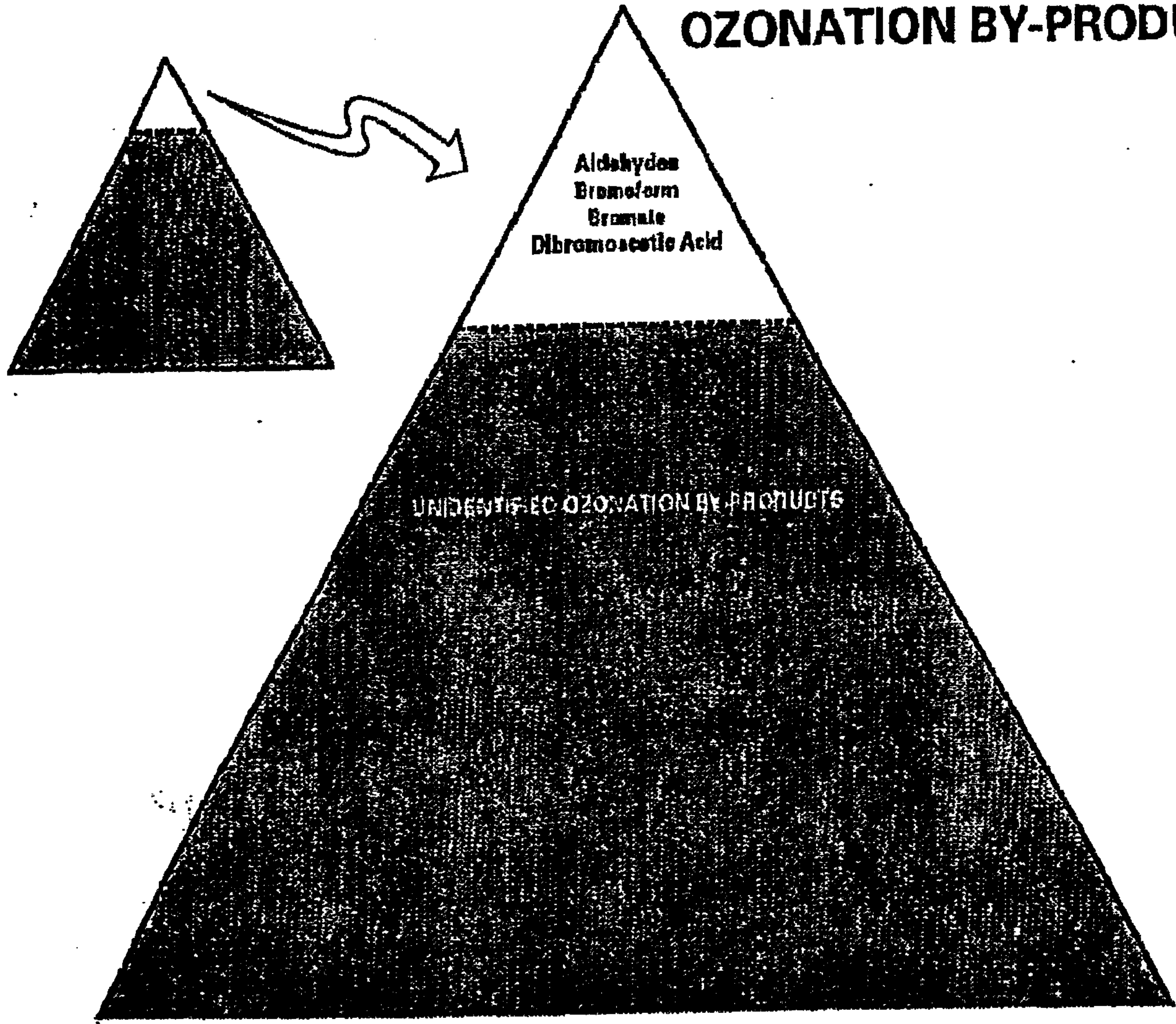


Figure 7

OZONATION BY-PRODUCTS



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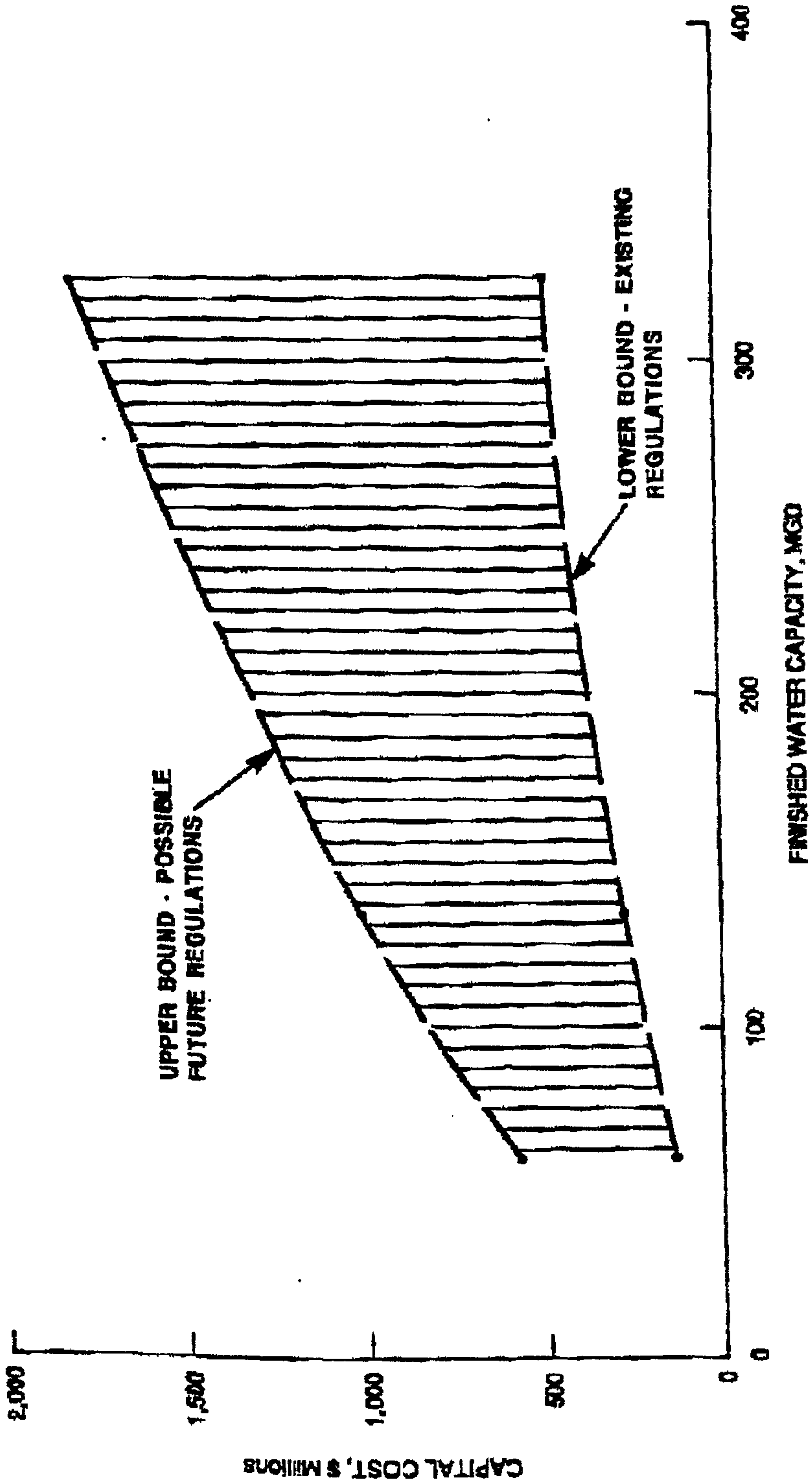

Figure 10 Estimated Capital Costs of Delta Water Treatment

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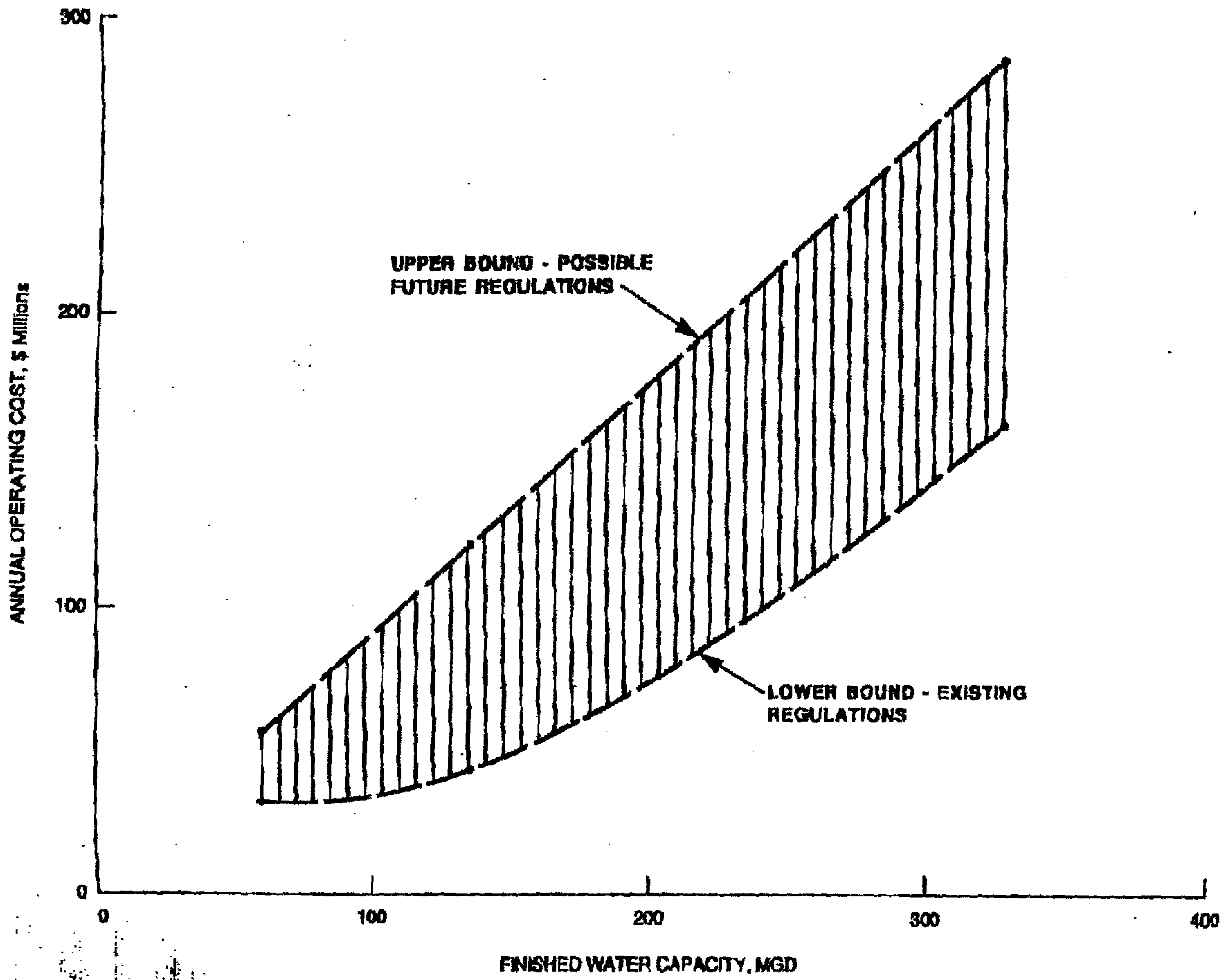

Figure 11 Estimated Annual Operating Costs of Delta Water Treatment